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Air Quality Enhancement Activity – Ozone Precursors

Ozone Precursors
Ozone is a gas composed of three oxygen atoms that is the primary component of smog. Although ozone in the upper atmosphere forms a layer that provides protection from ultraviolet radiation, ozone in the lower atmosphere and at ground level can be harmful. Ozone is not typically emitted directly from agricultural operations; rather, it is formed in the atmosphere through chemical reactions of nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight. NOx and VOCs are known as ozone precursors because they are the pollutants that form ozone in the lower atmosphere.

Ground-level ozone is an environmental issue as it can cause health problems related to the respiratory system, and safety and aesthetic issues by reducing visibility. These precursors react in the presence of sunlight to form ozone. In addition to respiratory and visibility issues, high atmospheric concentrations of ozone can cause considerable damage to agricultural crops, significantly reducing a grower's yield and profitability

Benefits
These activities will reduce emissions of ozone precursors (including volatile organic compounds [VOCs] and nitrogen oxides [NOx]), which lead to the formation of ozone.

Criteria for Ozone Precursors Enhancement Activity
This enhancement requires a participant to initiate or maintain **two or more** of the following activities that relate to their operation/enterprise.

Activities applicable to all enterprises:

- Properly store and dispense fuels, chemicals, and pesticides
- Replace older, less efficient combustion equipment with a more efficient, cleaner-burning, or non-combustion power source
- Maintain efficient operation of combustion sources
- Implement an inspection, maintenance, and housekeeping plan at your facility

Reference:

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Activities applicable primarily to cropping enterprises:

- Utilize activities that reduce pesticide drift
- Utilize a nutrient management system to reduce emissions of NOx

Activities applicable primarily to range and forest enterprises:

- Manage prescribed burning so that VOC and NOx emissions are minimized and/or their impacts on receptors of concern are minimized

Activities applicable mainly to orchards, vineyards, and agroforestry:

- Replace burning of orchard residues, trimmings, and removals with chipping, grinding or shredding

Activities applicable primarily to animal feeding enterprises:

- Use an approved feed management system with animal nutrition planning to reduce VOC emissions
- Utilize an appropriate manure management system which can reduce VOC emissions
- Use biofilters on enclosed structures to treat exhausts
- Use a wet scrubber or bioscrubber on enclosed structures to treat exhausts
- Use additives in animal housing and/or manure storage structures and areas
- Cover feed and other material storage piles, and minimize the exposed and disturbed pile surfaces

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1. Properly store and dispense fuels, chemicals, and pesticides (Ozone-01)

Fuels and agricultural chemicals which are exposed to the air have the potential to release volatile organic compounds (VOCs). Many VOCs are precursors to ozone production. Careful storage and dispensing of fuels and chemicals can reduce VOC emissions and help address concerns regarding ozone formation.

VOC emissions from handling and dispensing of volatile fuels and chemicals can be reduced by using a number of technologies, including, but not limited to:

1. **VOC recovery system (phase I)** - Equipment used to recover fuel vapors that escape between the fuel delivery trucks and the storage tanks.
2. **VOC recovery system (phase II)** - Equipment used to recover fuel vapors that escape when refueling equipment.
3. **Submerged fill pipe** – The storage vessel is loaded via a pipe that allows the liquid to enter at the bottom of the storage vessel to minimize disturbance and volatilization of the liquid.

Additionally, agricultural fuels and chemicals may be stored in covered and naturally or mechanically ventilated shelters to reduce heating and volatilization of the liquids or in completely enclosed structures that are vented to a VOC control device.

Required Elements:

- Attach proof of a VOC recovery or reduction system during handling and dispensing of agricultural fuels or chemicals or a dedicated agricultural fuel and chemical storage structure that minimizes VOC emissions.
- Briefly describe your evaluation of the effectiveness of the VOC recovery or reduction system or storage structure on VOC emissions from your operation.

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2. Replace older, less efficient combustion equipment with more efficient, cleaner-burning, or non-combustion power source (Ozone-02)

Older combustion sources, such as irrigation engines, boilers, water heaters, and other fuel-burning sources typically have greater emissions of volatile organic compounds (VOCs) and nitrogen oxides (NOx) due to less efficient combustion techniques. Replacing these sources with new equipment that is cleaner burning, meets new emission standards, or is a non-combustion power source (such as an electric motor) will generally reduce emissions of ozone precursors.

Required Elements:

- Attach proof of the replacement and removal of older, less efficient combustion engines with more efficient, cleaner-burning, or non-combustion power sources.

3. Maintain efficient operation of combustion sources (Ozone-03)

Combustion sources, such as irrigation engines, boilers, water heaters, and other fuel-burning sources emit volatile organic compounds (VOCs) and nitrogen oxides (NOx) as a result of the combustion process. Over time, and without proper maintenance and operation, these sources become less efficient and emit more VOCs and NOx. Proper operation and maintenance of fuel-burning sources can limit VOC and NOx emissions.

Required Elements:

- Provide a copy of the inspection, maintenance, and operating plan for the combustion sources at your site
- Provide documentation of inspection, maintenance, and operation conducted to implement the plan

4. Implement an inspection, maintenance, and housekeeping plan at your facility (Ozone-04)

Proper inspection, maintenance, and housekeeping activities can be a simple, yet effective way to minimize emissions of volatile organic compounds (VOCs). Examples of these activities may include, but are not limited to, the following:

1. Cleaning up spilled feed, manure, liquids, and other material expeditiously
2. Avoiding spillage of feed, manure, liquids, and other material
3. Inspecting and repairing water pipes, troughs, etc. for leaks

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4. Maintaining surfaces (open lots, bedding areas, etc.) to promote adequate drainage

Each of these relatively simple tasks, as well as other inspection, maintenance, and housekeeping activities, will help to minimize the conditions under which VOCs can be formed and emitted.

Required Elements:

- Provide a copy of a facility inspection, maintenance, and housekeeping plan for managing VOCs
- Provide documentation of inspection, maintenance, and housekeeping activities conducted to implement the plan

5. Utilize activities that reduce pesticide drift (Ozone-05)

Techniques for reducing pesticide drift, such as minimizing pesticide volatilization, more accurately and efficiently applying pesticides, and others that reduce overall pesticide usage, will also reduce volatile organic compound (VOC) emissions. Many of the VOC emissions from applied pesticides result from the evaporation of the inert carrier ingredients in pesticide formulations. Changing formulations to utilize dry powders or granules rather than liquids help to reduce VOC emissions. Using adjuvants, drift reducing nozzles, and lower pressures that reduce spray droplet size also can reduce VOC emissions by reducing the evaporation potential of the spray distribution. .

Any enhancements done with this activity must be above and beyond what is required for basic eligibility for participation in the program. Any enhancement gained through this activity should be in addition to what is also being carried out under the Water and Air Quality – Pest Management enhancement.

Required Elements:

- Briefly describe the pesticide drift reduction techniques used in your operation and provide your evaluation of the effectiveness of these techniques on reducing VOC emissions

6. Utilize a nutrient management system to reduce emissions of NOx (Ozone-06)

Nitrogen oxides (NOx) are important precursors to ozone formation. One of the sources of NOx is from the soil. Much of the NOx released from soils is a result of the nitrification/denitrification process in which ammonium (NH_4) is oxidized to NO_3 and then reduced to N_2. Managing ammonia production and conversion to nitrates will

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minimize NO_x production and release to the atmosphere. Activity examples would include nitrification inhibitors, split application of nutrients, and application of nutrients to more precisely match crop needs.

Note: This activity is only acceptable if it goes above and beyond that which is required for basic eligibility in USDA farm programs.

Required Elements:

- Provide documentation of the nutrient management system you use. Include methods of controlling nitrification, like nitrification inhibitors, split application of nutrients, and applying nutrients only to current crop needs.

7. Manage prescribed burning so that VOC and NOx emissions are minimized and/or their impacts on receptors of concern are minimized (Ozone-07)

When managed properly, prescribed burning can be accomplished to minimize emission of volatile organic compounds (VOCs) and nitrogen oxides (NOx), and to mitigate the impacts of those trace gases downwind on receptors of concern. The type of fuel being consumed and the completeness of combustion are two factors that help determine the amount of trace gases such as VOCs and NOx that are released from a fire. Many elements such as ignition technique, fuel moisture, weather conditions (wind speed, relative humidity, temperature, etc.) and fire type (backing fire, heading fire, etc.) contribute to the completeness of combustion. Smoke management practices can be employed to mitigate the local and downwind impact of emissions on receptors of concern, such as ozone nonattainment areas.

Required Elements:

- Provide certification of full implementation of a prescribed burn plan for each burn (including documentation of weather and fuel conditions), and that accepted methods for conducting prescribed burns were followed (see NRCS Prescribed Burning practice standard,CPS-338, specifications for details). Indicate how specific burn plan activities reduced VOC and/or NOx emissions, and how these activities helped control the downwind transport of these emissions (especially into sensitive areas, such as ozone nonattainment areas)

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8. Replace burning of orchard residues with chipping, grinding or shredding (Ozone-08)

Chipping, grinding or shredding orchard prunings reduces generation of volatile organic compounds (VOCs) and nitrogen oxides (NOx) that are released during the common practice of burning the prunings. The resulting product from chipping, grinding or shredding can also be used as mulch in orchards, elsewhere on the farm, or possibly sold as mulch to outside customers.

Required Elements:

- Attach receipt of purchase of chipping, grinding, and/or shredding machine or receipt from contractor hired to conduct chipping, grinding, and/or shredding
- Briefly describe the type of mulching machines purchased or used and your evaluation of their effectiveness
- Include signed form agreeing to replace burning with chipping, grinding or shredding
- Provide certification of the amount of mulch produced or sold

9. Use an approved feed management system with animal nutrition planning to reduce volatile organic compound (VOC) emissions (Ozone-09)

Feed management and animal nutrition planning control inputs to animals, which reduces undigested or partially digested compounds. This, in turn, reduces chemical concentrations in manure, as well as the potential for emissions of VOCs from the animals and their manure. Any producer using this enhancement activity shall adhere to the relevant design criteria put forth in Conservation Practice Standard 592, Feed Management.

Some management strategies that can be invoked include:

- Select livestock to genetically improve the efficiency of food conversion by the animal
- Feed less frequently
- Feed livestock based on sex, age and stage of production to match diet to nutritional requirements
- Provide feed with lower nitrogen and sulfur contents to reduce potential emissions of odorous compounds

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Required Elements:

- Provide a copy of a feed management plan which utilizes feed rations for managing animal and manure VOC emissions
- Attach receipts showing purchase of feed rations used to implement the feed management plan
- Briefly describe your animal operation (including number of animals, type of facility, and feed management plan) and your evaluation of the effectiveness of the feed management system on VOC emissions coming off your operation

10. Utilize an appropriate manure management system which can reduce volatile organic compound (VOC) emissions (Ozone-10)

The method of handling and storing manure can have a large impact on potential VOC emissions from the manure. Emission rates of VOCs are dependent upon many factors, such as:

1. Type of manure management system - Dry manure systems tend to reduce the ability of microorganisms to produce VOCs. Liquid manure systems may provide an opportunity to minimize volatilization of the VOCs by making them soluble in the liquid.
2. Aerobic vs. anaerobic manure management system – Aerobic systems are intended to produce carbon dioxide and water as byproducts; however, VOCs are intermediate products in that system, so providing excess oxygen and retention time can enable the microorganisms to break down a greater portion of the VOCs. Anaerobic systems are intended to produce methane, carbon dioxide, and water as byproducts; however, VOCs are produced as intermediate products in that system, so minimizing oxygen in the system and maximizing retention time can enable the microorganisms to break down a greater portion of the VOCs.
3. Amount of manure handling – The more manure is disturbed and/or exposed, there is more potential for volatilization and emission of any VOCs that are produced. Minimizing disturbance of the manure and contact with air will also minimize the potential for VOCs to volatilize.
4. Frequent removal of manure – Removing manure more frequently from animal areas will allow greater ability to manage manure in the storage and handling system. Manure that remains in animal areas will generally be more disturbed and may have more VOC emissions.

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Required Elements:

- Provide documentation of the manure management system you use, including the methods of manure handling and storage used to reduce VOC emissions from manure
- Briefly describe your evaluation of the effectiveness of the manure management system on VOC emissions from your operation

11. Use biofilters on enclosed structures to treat exhausts (Ozone-11)

A biofilter is a layer of organic material (woodchips, straw, compost, or other organic material) through which exhaust air from an animal building is passed. Microbes in the organic material convert volatile organic compounds (VOCs) to carbon dioxide and water. For a complete description of biofilter function, design, and operation criteria, see **Schmidt, Janni, and Nicolai, 2004, Biofilter Design Information, Biosystems and Agricultural Engineering Update 18, University of Minnesota Extension Service (http://www.manure.umn.edu/assets/baeu18.pdf).**

Required Elements:

- Attach design criteria and specifications, and operational specifications, for the biofilter specific to your operation. Include photographs of functioning biofilters on buildings at your operation
- Briefly describe your animal operation (including number of animals, type of facility, and biofilter placement) and your evaluation of the effectiveness of the biofilters to reduce VOCs coming off your operation

12. Utilize a wet scrubber or bioscrubber on enclosed structures to treat exhausts (Ozone-12)

A scrubber is an add-on control device designed to remove air pollutants from an exhaust stream via adsorption of the pollutants to a fixed media filter, a scrubbing liquid, or a combination of the two. A bioscrubber utilizes microbes in the scrubber to consume some or all of the pollutant compounds that are adsorbed. Wet scrubbers and bioscrubbers are effective at reducing VOCs from the air stream by making the VOCs soluble in the scrubbing liquid.

There are a variety of scrubber types that can be used to remove VOCs from exhaust air streams. In most cases, a producer should contact an air pollutant control technology design firm to assist in designing an exhaust gas scrubber system that meets the particular requirements (i.e., pollutants to control, size and operational limitations, etc.) for the farm

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site. The U.S. EPA has also developed fact sheets for many of the most common types of air pollution control technologies (including many types of scrubbers), which can be found at: http://www.epa.gov/ttn/catc/products.html.

Required Elements:

- Attach design criteria and specifications, and operational specifications, for the scrubber specific to your operation. Include photographs of functioning scrubbers or bioscrubbers on buildings at your operation
- Briefly describe your animal operation (including number of animals, type of facility, and dry scrubber placement) and your evaluation of the effectiveness of the scrubber to reduce VOCs coming off your operation

13. Use additives in animal housing and/or manure storage structures and areas (Ozone-13)

Additives are combined with manure to reduce production of volatile compounds (VOCs) from the manure. Many additives are an enzyme- or bacteria-based treatment which enhances bacterial populations in the animal manure for VOC consumption. Some additives counteract chemical compounds, while others absorb or adsorb chemical compounds. Some land grant universities have developed guidance, evaluation, and/or recommendations for specific applications of additives, and this information may be helpful in developing the manure additive plan. Any producer using this enhancement activity shall adhere to the relevant design criteria put forth in Conservation Practice Standard 591, Amendments for the Treatment of Agricultural Waste.

Required Elements:

- Provide a copy of your manure additive plan which utilizes additives to reduce VOC emissions from manure
- Attach receipts showing purchase of manure additives for use in the manure additive plan
- Briefly describe your animal operation, including number of animals, manure storage facilities, type and quantity of additives you use, and your evaluation of the effectiveness of additives to reduce VOC emissions from your operation

14. Cover feed and other material storage piles, and minimize the exposed and disturbed pile surfaces (Ozone-14)

The handling and storage of feed and other biological materials can have a large impact on potential volatile organic compound (VOC) emissions from these materials. As

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storage piles are increasingly disturbed and/or exposed there is greater potential for volatilization and emission of any VOCs that are produced. Minimizing disturbance of the piles and contact with air via covers or some other method of minimizing exposure to air will also minimize the potential for VOCs to volatilize.

Required Elements:

- Provide documentation of the methods used to minimize exposure of feed and other materials to air
- Provide documentation of the methods used to minimize disturbance of the pile and pile surface
- Briefly describe your evaluation of the effectiveness of the methods used to minimize VOC emissions from feed and other material storage piles at your operation